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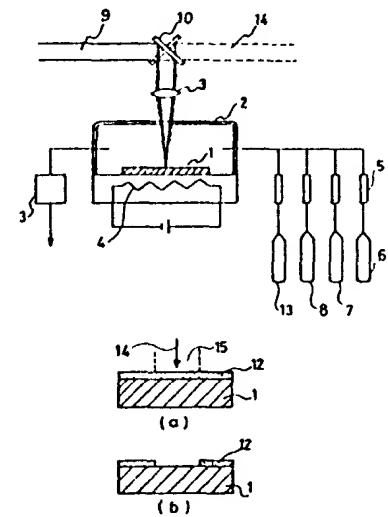
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## (54) MANUFACTURE OF SEMICONDUCTOR DEVICE

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 (71) FUJI DENKI SOUGOU KENKYUSHO K.K. (72) MISAO SAGA(2)  
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**PURPOSE:** To treat a semiconductor substrate without being exposed to the outside air by housing the semiconductor substrate in the same reaction chamber, introducing different reaction gases in succession and projecting beams imparting corresponding energy.

**CONSTITUTION:** A reaction chamber 2 is evacuated 3 and an Si substrate 1 is heated 4 at approximately 250°C, and SiH<sub>4</sub> 6, NO<sub>2</sub> 7 and N<sub>2</sub> 8 at predetermined flow rates are fed to keep the inside of the reaction chamber at approximately 10Torr. when the substrate 1 is irradiated and scanned by ArF laser beams 9, an SiO<sub>2</sub> film 12 is formed on the whole surface. When the introduction of the gases is stopped, the reaction chamber is evacuated and CFCI<sub>2</sub> is introduced and only a prescribed region 15 is irradiated by CO<sub>2</sub> laser beams 14, the SiO<sub>2</sub> film 12 is removed. According to the constitution, two processing processes can be executed in the same reaction chamber by utilizing an optical CVD method and other photochemical reactions, the substrate is not contaminated by the outside air, and the substrate need not be heated at a high temperature by utilizing the photochemical reactions and is not damaged.



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審査請求 未請求 発明の数 1 (全3頁)

⑭ 発明の名称 半導体装置の製造方法

⑮ 特願 昭59-73282

⑯ 出願 昭59(1984)4月12日

⑰ 発明者 佐賀 操 横須賀市長坂2丁目2番1号 株式会社富士電機総合研究所内  
⑱ 発明者 清水 了典 横須賀市長坂2丁目2番1号 株式会社富士電機総合研究所内  
⑲ 発明者 松崎 一夫 横須賀市長坂2丁目2番1号 株式会社富士電機総合研究所内  
⑳ 出願人 株式会社 富士電機総合研究所 横須賀市長坂2丁目2番1号  
㉑ 代理人 弁理士 山口巖

明細書

1. 発明の名称 半導体装置の製造方法

2. 特許請求の範囲

1) 半導体基板に対する連続した少なくとも二つの半導体加工工程を同一反応室内に半導体基板を収容し、該反応室内に異なる反応ガスを順次導入し、対応する反応エネルギーを与える光をそれぞれ照射することを特徴とする半導体装置の製造方法。  
(1:下2行)と

3. 発明の詳細な説明

[発明の属する技術分野]

本発明は、半導体基板に薄膜成長、不純物拡散、エッチングなどの一連の半導体加工工程を実施することによる半導体装置の製造方法に関する。

[従来技術とその問題点]

半導体装置の製造のためには、半導体基板の表面への不純物の付着、基板内への拡散、酸化膜、窒化膜あるいは金属膜の形成、フォトプロセスを利用した選択エッチング等の各種工程による半導体基板の加工が施される。しかし、これらの工程

において半導体基板が高温にさらされると、基板の熱変形あるいは熱応力による結晶欠陥の発生の問題がある。また、例えば半導体集積回路の集成度の増大に伴ない、接合あるいは配線設計の微細化、不純物濃度制御の高精度化への要求が強まり、プラズマによるエッチング、気相成長、化合物生成あるいはプラズマ中より引き出されたイオンビームによるエッチング、気相成長、化合物生成などの方法、またはイオン注入法などのいわゆるドライプロセスが採用されるようになった。しかしこれらの方法では結晶に損傷を生ずる問題がある。さらにこれらの一連の工程の中間には、半導体基板を一つの加工装置から取り出して他の加工装置へ入れるため、必然的に外部のふん囲気に半導体基板が触れることになり、その間に基板の汚染が生ずるおそれがある。二つの装置を連結し、外気に触れないように基板を移動することは、設備の占有面積が大きくなり、また設備費用も高価になる。

[発明の目的]

本発明は、上述の欠点を除き、連続した半導体加工工程の間に半導体基板を外気にさらすことのない半導体装置の製造方法を提供することを目的とする。

## 〔発明の要點〕

本発明によれば、半導体基板に対する連続した少なくとも二つの半導体加工工程を同一の反応室内に半導体基板に収容し、異なる反応ガスを順次導入し、対応する反応エネルギーを与える光をそれぞれ照射することによって行うことにより上記の目的が達成される。

## 〔発明の実施例〕

以下、本発明の実施のための装置を示す第1図ならびにシリコン基板を拡大して示す第2図を引用して、シリコン基板上に光化学反応を用いて酸化シリコン膜を形成する工程と、次いでその酸化シリコン膜の一部を除去して不純物導入のためのマスクパターンを形成する工程とからなる実施例について説明する。

シリコン基板1を反応室2の底部上に置き、反

を通しての露光、現像、エッチング、レジスト除去の各工程を必要としたものが、同一反応室内の連続工程に置き換えることができる。

## 〔発明の効果〕

本発明は、半導体基板に対する少なくとも二つの連続した加工工程をそれぞれ光CVD法その他の光化学反応を利用する方法によって同一反応室内で行うことにより、連続工程の間に半導体基板が外部のふん囲気に接触して汚染されることを防ぐものである。本発明の拡大によって半導体装置製造の全工程を同一反応室内の光照射で行うことも可能となる。さらに光化学反応を利用するにより半導体基板を高温度に加熱する必要がなく、また基板の損傷も起きる虞がないため、半導体装置の特性向上に極めて有効に適用できる。

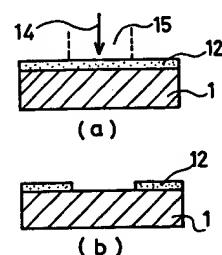
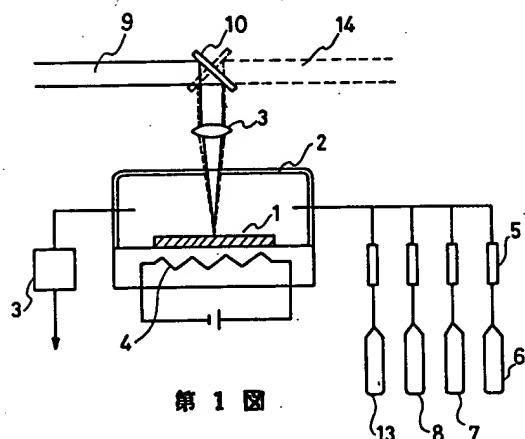
## 4. 図面の簡単な説明

第1図は本発明の一実施例のための装置の断面図、第2図は本発明の一実施例におけるシリコン酸化膜パターン形成の工程を順次示す断面図である。

応室内を真空ポンプ3により排気して真空にしたのち、基板1をヒーター4により約250°Cに加熱し、マスフローメータ5により流量を制御してポンベ6より SiH<sub>4</sub>ガスを5 ml/min、ポンベ7より N<sub>2</sub>Oガスを800 ml/min、キャリヤガスとしてポンベ8より N<sub>2</sub>ガスを65 ml/min導入し、10 Torr前後の圧力を保つ。そこへArFエキシマレーザの1930 Åの発振光9を鏡10、レンズ11を通して基板1の直上に照射し、走査することにより SiH<sub>4</sub> + 2N<sub>2</sub>O  $\xrightarrow{h\nu}$  SiO<sub>2</sub> + H<sub>2</sub> + 2N<sub>2</sub>の反応が起き、全面に第2図(a)に示すような酸化膜12を生ずる。次にポンベ6、7、8からのガスの導入を止め、反応室2内を排気した後ポンベ13より CFC<sub>2</sub>ガスを導入し、鏡10を回転して10.6 μmの波長を有する CO<sub>2</sub>レーザの発振光14を基板1の第2図(a)で点線で示した範囲15のみ照射する。これにより CFC<sub>2</sub> + SiO<sub>2</sub>  $\xrightarrow{h\nu}$  SiF<sub>2</sub>C<sub>2</sub> + CO<sub>2</sub>の反応が起り、SiF<sub>2</sub>C<sub>2</sub>の飛散により照射部分の SiO<sub>2</sub>膜12は第2図(b)に示すように除去される。これにより従来の方法では SiO<sub>2</sub>膜形成の熱酸化、レジストの塗布、フォトマスク

1 - シリコン基板、2 - 反応室、6 - SiH<sub>4</sub>ポンベ、7 - N<sub>2</sub>Oポンベ、8 - N<sub>2</sub>ポンベ、9 - ArFエキシマレーザ光、12 - SiO<sub>2</sub>膜、13 - CFC<sub>2</sub>ポンベ、14 - CO<sub>2</sub>レーザ光。

発明人介護士 山口



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Japanese Patent Laid-Open Number 60-216549

Laid open Date: October 30, 1985

Application No. 59-73282

Application Date: April 12, 1984

Applicant: Fuji Electric General Laboratory, Ltd.

Inventor: Misao Saga, et al.

IPC: H01L 21/302, 21/205

Patent attorney: Isao Yamaguchi

Title of the invention

Method for producing semiconductor devices

Specifications

1. Title of the invention

Method for producing semiconductor devices

2. What is claimed is:

1) A method for producing semiconductor devices,  
comprising the steps of:

performing at least two continuous semiconductor  
processing steps with respect to a semiconductor substrate by  
accommodating the semiconductor substrate in the same reaction  
chamber, introducing different reaction gases one after  
another in said reaction chamber, and irradiating lights which  
bring about reaction energies to the respective gases.

3. Detailed description of the invention

(Technical field of the invention)

The present invention relates to a method for producing

semiconductor devices by executing a series of semiconductor processing steps such as thin film growth, impurity diffusion, etching, etc.

(Prior arts and problems)

A semiconductor substrate is processed by various steps such as adhering of impurities onto the surface of the semiconductor substrate, diffusion thereof in the substrate, formation of oxide layer, nitride layer or metallic layer, selection etching utilizing a photoprocess, etc., in order to produce a semiconductor device. However, if the semiconductor substrate is exposed to a high temperature in these processes, such a problem occurs, which generates a defect in crystal due to thermal deformation or thermal stress of the substrate. Further, for example, in line with an increase in integration of a semiconductor integrated circuit, micronizing of bonding and wiring designs and high accuracy of controlling impurity concentration are highly requested. A method for etching, gas phase growth, compound generation by plasma, or a method for etching, gas phase growth, and compound generation by ion beams derived from the plasma, or an ion implantation method are recently employed as dry processes.

However, there is a possibility for crystal to be subjected to defects in these methods. Further, in the intermediate portion of the series of processing steps, the semiconductor substrates are unavoidably exposed to the outer

atmosphere in order to pick up the semiconductor substrates from one processing step and to introduce the same into another step. There is a fear that the semiconductor substrates are contaminated. If two apparatuses are connected to each other, and substrates are moved so that they are not exposed to the outer atmosphere, the area occupied by the apparatus will be increased, and facility costs will be made expensive.

(Objects of the invention)

The present invention removes the above shortcomings and problems, and it is therefore an object of the invention to provide a method for producing semiconductor devices in which semiconductors are not exposed to the outer atmosphere between continuous semiconductor processes.

(Summary of the invention)

According to the invention, the above object can be achieved by performing at least two continuous semiconductor processing steps with respect to a semiconductor substrate, wherein a semiconductor substrate is accommodated in the same reaction chamber, reaction gases different from each other are introduced one after another into said reaction chamber, and lights to give the corresponding reaction energies are irradiated thereon.

(Preferred embodiments of the invention)

Hereinafter, with reference to FIG. 1 which shows an apparatus for embodying the invention, and FIG. 2 which shows

a silicon substrate in enlargement, a description is given of the embodiment which comprises a process to form an oxide silicon layer using a photochemical reaction on a silicon substrate, and next a process to form a master pattern to introduce impurities by removing a part of the oxide silicon layer.

A silicon substrate 1 is placed on the bottom of a reaction chamber 2. After the reaction chamber is vacuumed by a vacuum pump 3, the substrate 1 is heated to approx. 250°C by a heater 4, wherein by controlling the flow volume of gases by a mass flow meter 5, an SiH<sub>4</sub> gas is introduced from a gas cylinder 6 at a rate of 5 milliliters per minute, an N<sub>2</sub>O gas is introduced from a gas cylinder 7 at a rate of 800 milliliters per minute, and an N<sub>2</sub> gas is introduced, as a carrier gas, from a cylinder 8 at a rate of 65 milliliters per minute, and pressure is kept at approx. 10 Torr. Then, a 1930Å oscillating light of an ArF excimer laser is irradiated immediately above the substrate 1 through a mirror 10 and a lens 11, and scanning is performed, whereby a reaction of SiH<sub>4</sub>+2N<sub>2</sub>O (hv) SiO<sub>2</sub>+H<sub>2</sub>+2N<sub>2</sub> occurs, and an oxide layer is produced on the entire surface as shown in FIG. 2(a). Next, an introduction of gases from the cylinders 6, 7 and 8 is stopped, and after the reaction chamber is purged, a CFCl<sub>3</sub> gas is introduced from a cylinder 13, wherein the mirror 10 is turned, an oscillating light of a CO<sub>2</sub> laser having a wavelength of 10.6μm is irradiated on only the range

shown by a dashed line in FIG. 2(a) in the substrate 1. Thereby, a reaction of  $\text{CFCl}_3 + \text{SiO}_2 \rightarrow (\text{hv}) \text{SiF}_2\text{Cl}_2 + \text{CO}_2$  occurs. By scattering of  $\text{SiF}_2\text{Cl}_2$ , the  $\text{SiO}_2$  film 12 at the irradiated portion is removed as shown in FIG. 2(b). Thereby, although the prior art requires various processes such as thermal hardening for  $\text{SiO}_2$  layer formation, coating of a resist, exposure through a photomask, developing, etching, removal of the resist, they can be replaced by one continuous process which can be carried out in the same reaction chamber.

(Effects of the invention)

In the invention, at least two continuous processes with respect to semiconductor substrates can be carried out in the same reaction chamber by an optical CVD method or other methods utilizing a photochemical reaction, and it is possible to prevent the semiconductor substrates from being contaminated in contact with the outer atmosphere between continuous processes. By expanding the invention, all the processes of producing semiconductor devices can be performed by optical irradiation in the same reaction chamber. Still further, it is not necessary to heat semiconductor substrates to a high temperature by utilizing a photochemical reaction, and there is no fear that the substrates are damaged. Therefore, a method according to the invention can be remarkably effectively utilized in improving the characteristics of semiconductor devices.

#### 4. Brief description of the drawings

FIG. 1 is a cross-sectional view of an apparatus for one preferred embodiment of the invention, and FIG. 2 is a cross-sectional view showing processes for forming a silicon oxide layer pattern one after another in one preferred embodiment of the invention.

1...Silicon substrate, 2...Reaction chamber, 6...SiH<sub>2</sub> cylinder, 7...N<sub>2</sub>O cylinder, 8...N<sub>2</sub> cylinder, 9...ArF excimer laser light, 12...SiO<sub>2</sub> layer, 13...CFCl<sub>3</sub> cylinder, 14...CO<sub>2</sub> laser light